UNIVERSITI PUTRA MALAYSIA

DEVELOPING AN EXPERT SYSTEM TO PREDICT THE EFFECT OF SELECTIVE LOGGING ON LARGE MAMMALS

MOUTASIM GAMMAR ELDIN ISMAIL

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DEVELOPING AN EXPERT SYSTEM TO PREDICT THE EFFECT OF SELECTIVE LOGGING ON LARGE MAMMALS

By

MOUTASIM GAMMAR ELDIN ISMAIL

Thesis Submitted in Fulfilment of the Requirement for the Degree of Master of Science in the Faculty of Engineering Universiti Putra Malaysia

January 2001

UPM

DEDICATION

To the soul of my father Gamar Eldin

To my beloved wife Dar Elnaiem,

daughter Eithar, son Gamar Eldin

and all my family

I dedicate this work with great love and appreciation for their kindness,

Encouragement and effort

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

DEVELOPING AN EXPERT SYSTEM TO PREDICT THE EFFECT OF SELECTIVE LOGGING ON LARGE MAMMALS

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MOUTASIM GAMAR ELDIN ISMAIL

January 2001

Chairman: Mohamed Bin Daud, Ph.D., MBA.

Faculty: Engineering

Expert systems have started to play an important role in this era of knowledge. As we move from information age to knowledge age, management and organization of human expertise will have a great impact in all aspects of life in terms of time saving and money.

An expert system (ES) to predict the effect of selective logging on large mammals was developed through a combination of results from field survey, interviews with domain experts and data from Department of Wildlife and National Parks, Malaysia. The field survey was carried out for track identification of four large mammals (barking deer, sambar deer, tapir and wild boar), vegetation and microclimate measurements. ANOVA analysis of variance, regression and sensitivity analysis were used to test the data. The problems related to selective logging and the various aspects of its effects on large mammals were translated into specific rules and incorporated into the ES. The data and information were stored in databases, which

can be updated and referred to in the ES. The program provides information for courses and teaching purposes as well as acting as advisor to draw conclusions. In addition to this it helps wildlifers and foresters on decision making on the effect of selective logging on large mammals.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains.

PEMBANGUNAN SISTEM PAKAR UNTUK MERAMALKAN KESAN PENEBANGAN POKOK TERPILIH PADA MAMALIA

Oleh

MOUTASIM GAMAR ELDIN ISMAIL

January 2001

Pengerusi: Mohamed Bin Daud, Ph.D., MBA.

Fakulti: Kejuruteraan

Sistem Pakar memainkan peranan penting dalam era pengetahuan kini. Perubahan kepakaran manusia daripada era maklumat kepada pengurusan pengetahuan dan organisasi akan memberikan kesan yang baik dalam semua aspek kehidupan dalam ertikata menjimat masa dan wang.

Sistem Pakar atau (Expert System) untuk meramal kesan tempat tinggal keatas mamalia besar telah dibina melalui gabungan keputusan daripada lapangan, temuduga dengan pakar utama dan data daripada jabatan perlindungan hidupan liar dan taman negara Malaysia. Lapagan kajian dijalankan dengan mengenalpasti jejak empat kumpulan erbesar mamalia (rusa 'barking', rusa "sambar', tapir dan babi liar), kumpulan tumbuhan dan penentuan cuaca-mikro. Anova analisa varians, regrasi dan sensitiviti telah digunakan untuk menguji data. Masalah berhubung dengan pemilihan tempat tinggal dan pelbagai aspek yang memberi banyak kesan kepada mamalia besar telah ditukar kepada peraturan tertentu dan termaktub dalam sistem pakar. Data dan

maklumat disimpan dalam pengelasan data dan boleh ditingatkan dan di rujuk melalui sistem pakar. Program ini menyediakan maklumat untuk kursus kursus dan tujuan pengajaran sebagai mana disarankan oleh penasihat. Perkara ini juga membantu hidupan liar dan rimbawan untuk membuat keputusan atas kesan memilih tempat tinggal mamalia besar.

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My special thanks to all members of the Expert System Group, Faculty of Engineering, for their helps co-operation and assistance.

Last but not least, my thanks to my blessed mother Khadeega who has always prayed for me, my brothers Ismail, Omar, Khaleel, Abbas, Mahmood, Talal, and my sisters Fatima, Inam, Amna, Tegwa, Ferha, and Merwa for there encouragement.

On top of all, praise is to the Almighty Allah S. W. T. I would not have been able to complete this study without His help.

I certify that an Examination Committee met on January 9th 2001 to conduct the final examination of Moutasim Gamar Eldin Ismail on his Master of Science thesis entitled "Developing An Expert System to Predict the Effect of Selective Logging on Large Mammals" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. The Committee Members for the candidate are as follows:

WAN ISHAK WAN ISMAIL, Ph.D.
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Mohamed Bin Daud, Ph.D., Ir.
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Member)

Mohamed Zakaria Hussin, Ph.D.
Lecturer
Faculty of Forestry
Universiti Putra Malaysia
(Member)

Mohd. Zohadie, Ph.D., Ir.
Professor
Faculty of Engineering
Universiti Putra Malaysia
(Member)

MOHD GHAZALI MOHAYIDIN, Ph.D.
Professor/Deputy Dean of Graduate School
Universiti Putra Malaysia

Date: 06 FEB 2001

This thesis submitted to the Senate of Universiti Putra Malaysia has been accepted as fulfilment of the requirement for the degree of Master of Science.

MOHD. GHAZALI MOHAYIDIN, Ph.D.
Professor
Deputy Dean of Graduate School
Universiti Putra Malaysia
Date:

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I declare that this thesis has not been previously or concurrently submitted for any other degree at UPM or any other institutions.

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(Moutasim Gamar Eldin Ismail)

Date:

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ft	Feet
h	Hour
AI	Artificial Intelligence
FR	Forest Reserve
GUI	Graphical User Interface
IE	Inference Engine
IUCN	International Union for Conservation of Nature and Natural Resources
KB	Knowledge Base
LHS	Left Hand Side
LISP	Programming Language based on list processing.
LRB	Langat River Basin
MYCN	A classic expert system developed to diagnose Infectious blood diseases and help doctors recommend the appropriate treatment.
PROLOG	Program in Logic
PROSPECTOR	An expert system for helping to find ore deposits
RHS	Right Hand Side
TMP	Third Malaysia Plan
UKM	Universiti Kabansaan Malaysia
VJR	Virgin Jungle Forest
WM	Working Memory

CHAPTER I

INTRODUCTION

The problem of selective logging and its effect on fauna and flora has recently become an important issue and there is a need for more public awareness and consciousness.

The overall objective of this study is to develop an expert system to predict the effect of selective logging on large mammals. This is accomplished by using primary data from field survey and observations of four species of large mammals (tapir, wild boar, sambar and barking deer), and secondary data from interviews with two wildlife experts on six large mammals (elephant, seladang, rhino, tiger, leopard and sun bear).

Vegetation cover and microclimate measurements at three compartments in Sungai Lalang Forest Reserve, and data from various sources mainly interviews with wildlife experts were used. All types of data were integrated with statistical analysis that provided numerical relations. This data was incorporated in the expert system using rules in the form of IF and THEN.

Statement of the Problem

In Malaysia, of an estimated 19.8 million ha of remaining forest in 1986, 14.8 million ha (74.7%) were reserved as production forests and subject to selective logging (Lambert, 1992).

Economic development is almost inevitably synonymous with disturbance or destruction of the natural habitat. The prospects for survival of rain-forest wildlife in such areas are bleak (John 1985). Therefore, study on development activities resulting in varied habitat destruction and effects on the existing wildlife are necessary.

In order to protect and conserve natural forest and to maintain its unique biological diversity, it is important to increase public awareness and education level of conservation issues. It is also important to provide a reliable management tool to assist decision-makers to achieve at the favor of conservation. This study is an attempt to help those people in increasing awareness, making decision and providing information to end-users.

Objectives

The purpose of this study is to assist management in predicting the effect of selective logging on large mammals. The specific objectives of this study are:

1. To study the effect of selective logging on large mammals.
2. To study the effect of selective logging on micro-climatic variables and their relation to the effect on large mammals.
3. To extract knowledge in relation to the effect of selective logging on large mammals.
4. To develop a comprehensive expert system to predict the effect of selective logging on large mammals. This expert system will be used as a tool to assist people to react to the problem of selective logging. It can also be used to increase public awareness, teaching, decision-making, management and development.

Significance of the Study

Knowledge could be incorporated into an expert system. This expert system can predict the level of selective logging that affects, the impacts on mammals inhabiting the forest and the extent of damage on the forest.

The expert system can provide predictions on the degree and/or the type of effects that may occur when applying specific percentage of selective logging. This should increase cautiousness about the practice of selective logging.

Most important is that this expert system can become a very useful managerial tool for wildlife and forestry departments. It can be used as a powerful tool to increase awareness and to assist in decision-making.

The expected outcome of this research is an expert system that can be used in predicting the effect of selective logging on large mammals. The knowledge about selective logging, its effects and the possible mitigation measures is incorporated in such expert system.

Expected Results of the Study

The outcome of this study is to provide information on large mammals and their relation to selective logging and micro-climatic variables. This knowledge was extracted from field survey and domain experts. It was incorporated into an expert system that can be used for predicting the effect of selective logging on large mammals in Malaysia. It includes the percentage of logging, forest size and food availability. It is visualized that the ES would become a very useful prediction and decision-making tool. The expert system developed could only be used to evaluate